

**Report of Energy Efficiency Study and
Metering/Utilities Profile for Electricity Deregulation at the
Texas A&M University at Commerce (TAMU-Commerce)
Commerce, Texas**

Submitted to

**Texas A&M University at Commerce
The Texas A&M University System**

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Acknowledgement

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Executive Summary

The energy costs for TAMU-Commerce are very high when compared to most of the other universities in the TAMUs. For example, the price of \$1.6 per square foot per year for utilities is nearly twice that of the Kingsville or Tarleton campuses. This gives us, however, an excellent opportunity for improving energy efficiency.

Energy Savings Potential for the Campus

Our estimates of savings for the entire campus, through commissioning and minor control upgrades, are nearly \$300,000 annually. If we concentrate on the 11 largest opportunities, representing nearly 50% of the conditioned square footage, savings of over \$200,000 could be achieved. Some capital will be required, however, to achieve these savings, because there are a number of systems currently not operating or are bypassed.

Some of the needed hardware may be installed by the performance contractor, CSI, as part of the pending performance contract. After the installation and verification of the equipment in the performance contract, it is recommended that the campus buildings and plants be commissioned.

Commissioning Targets Ranked by Potential Energy Savings

1. James Gee Library
2. Memorial Student Center
3. McDowell Administration
4. Hall of Science
5. Agriculture
6. Ferguson Social Science
7. Binnion Hall
8. Henderson Hall
9. Journalism
10. Hall of Language
11. Sowers Education South

Metering Recommendations for Electric Deregulation

The electrical data can be obtained from TXU, or the data could be obtained by installing our ESL metering equipment and polling from College Station. These alternatives are discussed in the report.

Table of Contents

EXECUTIVE SUMMARY.....	i
ENERGY EFFICIENCY STUDY.....	1
General Introduction.....	1
Energy Savings Potential for the Campus and the Top Commissioning Targets...	2
Summary of Building Information and Major Recommended Energy Measures..	2
Library – Old Section.....	2
Library – Old New Section.....	3
Library – New Section.....	3
Memorial Student Center – New Addition.....	3
Memorial Student Center – Old Section.....	4
McDowell Administration Building	5
Hall of Science.....	5
Agriculture Building – New Section.....	6
Agriculture Building – Old Section.....	6
Ferguson Social Science.....	6
Binnion Hall.....	7
Journalism Building.....	7
Henderson Hall.....	8
Hall of Language.....	8
Sowers Education South.....	9
Halladay Student Service Building.....	9
Instructional Printing Facility.....	9
Youth Education North.....	10
Field House.....	10
Performing Arts Center.....	10
Whitley Hall.....	11
Whitley Gym.....	11
Art Building.....	11
Music Building.....	12
Zeppa Recreation Center.....	12
Key Hall.....	12
Electricity Deregulation Metering Options.....	13
Utility Bill Summary.....	14

Energy Efficiency Study

General Introduction

Texas A&M University-Commerce is the second largest university in the Texas A&M University System and one of the system's three newest members. It is located in Commerce, Texas. Formally known as East Texas State University, it joined the Texas A&M System and became Texas A&M University-Commerce on September 1, 1996.

There are 120 buildings on the campus with a total conditioned area of approximately 1,260,000 square feet. Twenty-two (22) major buildings account for 80% of the conditioned area, or 1,008,000 square feet. There are three (3) mini chiller plants that supply chilled water to buildings on those loops, with capacities of 1000 ton, 450 ton, and 400 ton, respectively. Other buildings either have their own chillers or have package rooftop units. There are two 600 hp boilers in one mini-plant that supply 75 psi steam to some buildings on the campus. Other buildings have their own hot water boilers. The types of air handling units (AHUs) include multi-zone units, dual-duct units, single-duct VAV units, and coupled control units. CSI control system has been installed in the 22 major buildings noted above for about nine (9) years.

The electricity and natural gas are provided by TXU. For fiscal year 1997, the total electric and gas costs were \$1,525,004 and \$476,380, respectively. This translates to approximately \$1.60/ft² of conditioned area.

The ESL conducted a survey on the campus from August 18 to August 20, 1999. All 22 major buildings were covered during the walk-through. It was found that the HVAC systems were poorly maintained. Some filters had not been changed for some time and were clogged and dusty. A lot of outside air damper linkages were disconnected. Two fan belts were found broken. Most cooling coils and some heating coils did not have control valves and hence were running wild. Even with the units that had chilled water control valves, most were bypassed from the control program and ran wild.

During the cooling season, all the boilers are shut down and no heating is provided for reheat purposes. During the heating season, no cooling is provided either. There are no reset schedules for the cold deck temperature, hot deck temperature, or hot water supply temperatures. All cold deck temperatures were set at 55°F or 50°F constant. Most of the cold deck temperatures were measured to be very low, ranging from 46°F to 52°F.

In the main chiller plant with one 1000 ton chiller, there are two 50 hp secondary chilled water pumps that are equipped with VFDs. However, the VFDs were being bypassed and the two chilled water pumps were running at constant 100% speed. For some VAV AHUs, there were either no speed controls or the controls were bypassed and the fans ran at full speed.

There is a clear need for major re-commissioning of the buildings, which will include some capital investment for improved control. Operating staff training and regular preventive maintenance are also badly needed.

CSI is proposing a \$3 million dollars performance contract with TAMU-Commerce. The draft proposal has been reviewed by the TAMU Facilities Planning and Construction office, and should be submitted to the Higher Education Coordinating Board for approval in either December 1999 or January 2000.

The following sections summarize the energy savings potentials and the findings of the survey.

Energy Savings Potential for the Campus and the Top Commissioning Targets

Energy Savings Potential

Electricity: \$115,000/year or 8%
Natural gas: \$85,000/year or 18%
Total: \$200,000/year or 10%

Top 11 Commissioning Lists

	Floor area (ft ²)
1. James Gee Library	105,887
2. Memorial Student Center	87,823
3. McDowell Administration	75,970
4. Hall of Science	67,811
5. Agriculture	62,002
6. Ferguson Social Science	45,130
7. Binnion Hall	35,899
8. Henderson Hall	34,526
9. Journalism	25,450
10. Hall of Language	25,582
11. Sowers Education South	24,171
Total	590,251

Summary of Building Information and Major Recommended Energy Measures

Library-Old Section

Building information

The building obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 275 ton chiller that is out of service. One 7.5 hp chilled water pump serves the building. Steam from the boilers in the Journalism Building is used to produce hot water. There is one 5 hp hot water pump for the heating and reheat coils in this section, as well as the reheat coils for the new library (3rd to 5th floor).

There are two AHUs in this building. They used to be multi-zone units and were retrofitted to VAV systems later on by blocking the heating coils and installing VAV

reheat boxes at individual zones. However, no control valves were installed at the cooling coil and no speed controls were provided for the supply air fans. After the retrofit, there were a lot of cold complaints. So the maintenance staff put back the mixing zone actuators for the zones that were cold and unblocked the heating coils. When the outside air temperature is below 60°F, the economizer cycle is enabled. Outside air and return air dampers are modulated to control the mixed air temperature at the setpoint of 55°F.

Recommendations

1. Calibrate cold deck temperature sensors.
2. Install control valves for the cooling coils.
3. Reset cold deck temperatures based on outside air temperature.
4. Install VFDs for the supply air fans.
5. Optimize the economizer cycle control.

Library-Old New Section

Building information

The building obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 7.5 hp building chilled water pump. Steam from the boilers in the Journalism Building is used to produce hot water. There is one 3 hp hot water pump for the heating coil.

There are two dual-duct AHUs with supply and return fans. No control valves are installed in the cooling and heating coils. Cold deck temperature for AHU #1 was measured to be 50°F.

Recommendations

1. Calibrate cold deck and hot deck temperature sensors.
2. Install control valves for the cooling and heating coils.
3. Reset cold deck and hot deck temperatures based on outside air temperature.

Library- New Section

Building information

The building obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 7.5 hp building chilled water pump. It shares the hot water pump with the old section.

There is one single-duct AHU with VAV reheat boxes. It has a two-speed motor but the wiring was setup for one speed only. Consequently, the unit is running at full speed all the time. The outside air damper is disconnected.

Recommendations

1. Calibrate cold deck temperature sensor.
2. Reset cold deck temperature based on outside air temperature.
3. Install a VFD for the supply air fan.

4. Optimize the static pressure reset schedule.
5. Reactivate and optimize the economizer control.

Memorial Student Center-New Addition

Building information

This building houses offices and a bookstore. There is a mini-plant in this building. A 450 ton Trane chiller is in series with a smaller chiller. However, the smaller chiller is no longer in service. This plant serves the Memorial Student Center addition and the Business Administration (BA) Building. It is isolated from the chilled water loop served by the chillers in the Journalism Building because of operational problems. There is one 40 hp chilled water pump for the BA Building and one 40 hp chilled water pump for this MSC addition. There are two 200 hp boilers. The hot water supply temperature is manually reset between 120 to 140°F.

There are five multi-zone AHUs in this building. The cooling coils and the heating coils have control valves. However, the chilled water control valves do not seem to be controlling the cold deck temperatures. All the cold deck temperatures are very low, ranging from 48.5°F to 50°F. Zone thermostats are used to control the mixing dampers for each zone.

Recommendations

1. Calibrate the cold deck and hot deck temperature sensors.
2. Reset cold deck and hot deck temperatures based on outside air temperature.
3. Provide automatic reset for the hot water supply temperature.

Memorial Student Center-Old Section

Building information

This building houses offices, a ballroom and a cafeteria. There is one 280 ton Carrier chiller and one boiler for this building. Hot water supply temperature is manually reset between 120 to 140°F.

There are three multi-zone and one single-zone AHUs in this building. There are no control valves for the cooling and heating coils.

Recommendations

1. Calibrate the cold deck and hot deck temperature sensors.
2. Install control valves for the AHUs' cooling and heating coils.
3. Reset cold deck and hot deck temperatures based on outside air temperature.
4. Provide automatic reset for the hot water supply temperature.

McDowell Administration Building (BA)

Building information

This building houses offices and classrooms. There is one 15 hp chilled water pump that obtains chilled water from the chiller in MSC-new addition. There are two chilled water pumps for the fan coil units, which have electric reheat. There is one 2 hp hot water pump that obtains hot water from the boiler in the MSC-new addition.

There are three dual-duct AHUs. The cooling coils and the heating coils have control valves. There are no reset schedules for the cold deck and hot deck temperatures. Cold deck temperature setpoint is 55°F and hot deck temperature setpoint is 110 to 120°F constant. However, the cold deck temperatures were measured from 47°F to 51°F. The room thermostats control the mixing dampers. When the outside air temperature is below 60°F, the economizer cycle is enabled. Outside air and return air dampers are modulated to control the mixed air temperature at the setpoint of 55°F.

Recommendations

1. Calibrate cold deck and hot deck temperature sensors.
2. Reset cold deck and hot deck temperatures based on outside air temperature.
3. Optimize the economizer cycle control.

Hall of Science (Earth Science, Middle Science, and Old Science)

Building information

This building houses offices, classrooms and labs. It consists of three sections, the Earth Science, the Middle Science, and the Old Science. It obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 7.5 hp chilled water pump for the Earth Science section and one 15 hp chilled water pump for the Middle Science section. The Old science section has a 2-pipe system with 17 FCUs. There is one 860,000 Btu/h boiler that supplies hot water to the AHUs.

AHU #1 serves the Earth Science section. It is a dual-duct system. AHU #2 and AHU#3 serve the Middle Science section. The building seems to be getting return chilled water from the loop. All the chilled water supply temperatures at the coils were around 54°F. Further investigation is needed since when the old chiller was pulled out of service, its chilled water pump was used as the building pump, and the flow direction of the chilled water pump may be reversed.

Recommendations

1. Calibrate cold deck and hot deck temperature sensors.
2. Reset cold deck and hot deck temperatures based on outside air temperature.
3. Investigate the piping configuration.

Agriculture Building-New Section

Building information

This building houses offices and classrooms. There are four air-cooled chillers on the rooftop of this building. Hot water is supplied from the adjacent old Agriculture Building.

There are two multi-zone AHUs and two single-zone AHUs. Because of an air balance problems, one of the multi-zone (9-zone) AHUs has been converted to a single-zone unit by using the return air thermostat to control all 9 zone mixing dampers. When the outside air temperature is below 60°F, the economizer cycle is enabled. Outside air and return air dampers are modulated to control the mixed air temperature at the setpoint of 55°F.

Recommendations

1. Calibrate the cold deck and hot deck temperature sensors.
2. Reset the cold deck and hot deck temperatures based on outside air temperature.
3. Optimize the economizer cycle control.
4. Perform air balance if necessary.

Agriculture Building-Old Section

Building information

This building houses offices and classrooms. There is one boiler in this building. The hot water supply temperature is limited to below 110°F since the hot water pipe is made of fiberglass.

There are two rooftop units with DX cooling and gas heating. Another three rooftop units have DX cooling only.

Ferguson Social Science

Building information

This building houses classrooms and offices. It obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 10 hp building chilled water pump. Steam from the boilers in the Journalism Building is used to produce hot water. There is one 5 hp hot water pump for reheat.

There are three AHUs that are single-duct VAV with terminal reheat. Cold deck temperatures are controlled at the setpoint of 55°F. The outside air damper for AHU #2 was found disconnected.

Recommendations

1. Calibrate cold deck temperature sensors.
2. Reset cold deck temperatures based on outside air temperature.
3. Optimize the static pressure set points.
4. Reconnect the outside air damper.

Binnion Hall

Building information

This building houses classrooms and offices. It obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 25 hp building chilled water pump. Steam from the boilers in the Journalism Building is used to produce hot water.

There are two multi-zone AHUs. No control valves are installed for the heating and cooling coils. For the AHU in the basement, its belt was found broken and the outside air damper was disconnected. The first and second floors of the building are served by FCUs.

Recommendations

1. Calibrate cold deck and hot deck temperature sensors.
2. Install control valves for the cooling coils and heating coils.
3. Reset cold deck and hot deck temperatures based on outside air temperature.
4. Reconnect the outside air damper.

Journalism Building

Building information

This building houses offices, classrooms, photo labs, and one auditorium. There is one mini-plant in the basement of the building. The primary chilled water loop has one 1000 ton Trane chiller in operation. One 350 ton Trane chiller and one 375 ton Carrier chiller are not operable. However, both chillers that are off have their valves open and are bypassing the chilled water. Two secondary chilled water pumps are equipped with VFDs, but the VFDs are bypassed and the pumps are running at constant 100% speed. There is one 30 hp constant speed chilled water pump for this building.

There are two 600 hp boilers that supply 75 psi steam to the campus. Normally, one of the boilers is manually turned on when outside air temperature is below 40~45°F. When it becomes warm in the spring, the boiler is turned off. The steam pressure is reduced to 12 psi in most buildings. Some buildings use the steam directly for heating, most buildings use the steam to produce hot water for heating.

There are two multi-zone AHUs and one single-zone AHU for this building. When the outside air temperature is below 60°F, the economizer cycle is enabled. Outside air and return air dampers are modulated to control the mixed air temperature at the setpoint of 55°F. For the multi-zone AHUs, the cooling and heating coils run wild. Filters are dirty, and outside air dampers are manually closed to prevent freezing. The belts for the fans are loose, and chilled water return temperature is only 49°F. For the single-zone AHU that serves the auditorium, its cooling coil runs wild. But the heating coil has a 3-way control valve.

Recommendations

1. Isolate the two chillers that are no longer in service from the primary loop.
2. Restore speed control for the two secondary chilled water pumps.
3. Calibrate cold deck and hot deck temperature sensors.
4. Install control valves for the AHUs cooling and heating coils.
5. Reset cold deck and hot deck temperatures based on outside air temperature.
6. Optimize the economizer cycle control.

Henderson Hall

Building information

This building houses classrooms, offices and a clinic. It obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 15 hp building chilled water pump. Steam from the boilers in the Journalism Building is used to produce hot water.

There is one multi-zone AHU on the first floor and three coupled-control AHUs in the attic. The outside air damper for the multi-zone AHU is disconnected. There is no chilled water control valve at the cooling coil for the multi-zone unit.

Recommendations

1. Calibrate cold deck and hot deck temperature sensors.
2. Install a control valve for the cooling coil.
3. Reset cold deck and hot deck temperatures based on outside air temperature.

Hall of Language

Building information

This building houses offices and classrooms. The building chilled water pump is broken. However, the primary loop pressure is high enough to circulate chilled water to the building. Steam from the boilers in the Journalism Building is used to produce hot water. The building hot water pump is also down. Consequently, there is no hot water for the terminal reheat coils.

There are two single-duct AHUs in this building. The outside air dampers are closed and the filters are clogged. The fan belts are loose. Although they serve different floors, the average space temperatures from sensors located in different floors are used to control the face and bypass damper and heating coil for *both* units.

Recommendations

1. Repair the chilled water and hot water pumps.
2. Install chilled water control valves for the AHUs.
3. Reset cold deck temperatures based on outside air temperature.

Sowers Education South

Building information

This building houses classrooms and offices. It obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 15 hp building chilled water pump. Steam from the boilers in the Journalism Building is used to produce hot water. There are two 3 hp hot water pumps.

There are five coupled-control AHUs, which are either cooling or heating. The supply air temperature at one unit was measured to be 51°F. There are two single-zone face and bypass AHUs and one multi-zone AHU. No control valves are installed in these units. When the outside air temperature is below 60°F, the economizer cycle is enabled. Outside air and return air dampers are modulated to control the mixed air temperature at the setpoint of 55°F.

Recommendations

1. Calibrate cold deck temperature sensors.
2. Install control valves for the heating and cooling coils.
3. Reset cold deck and hot deck temperatures based on outside air temperature.
4. Optimize the economizer cycle control.

Halladay Student Service Building

Building information

This building houses offices. There is one 150 ton chiller in the building. One single-duct AHU serves this building. There is no control valve for the cooling coil. It uses electric reheat and has an economizer. When the outside air temperature is below 60°F, the economizer cycle is enabled. Outside air and return air dampers are modulated to control the mixed air temperature at the setpoint of 55°F. All the breakers for the reheat are turned off during the summer.

Recommendations

1. Calibrate the cold deck temperature sensor.
2. Install a control valve for the cooling coil.
3. Reset cold deck temperature based on outside air temperature.
4. Optimize the economizer cycle control.

Instructional Printing Facility

Building information

This is a printing shop. This building obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 2.5 hp building chilled water pump. Steam from the boilers in the Journalism Building is used to produce hot water. There are two (2) 1 hp hot water pumps.

There are two single-zone face and bypass AHUs. No control valves are installed in the cooling coils. When the outside air temperature is below 60°F, the economizer cycle is

enabled. Outside air and return air dampers are modulated to control the mixed air temperature at the setpoint of 55°F.

Recommendations

1. Calibrate the cold deck temperature sensors.
2. Install control valves for the cooling coils.
3. Optimize the economizer cycle control.

Young Education North

Building information

This building houses offices and classrooms. It obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 5 hp building chilled water pump. There is one 880,000 Btu/hr boiler.

There is one single-duct VAV terminal reheat AHU. The chilled water valve is controlled by the return air temperature. The supply air fan inlet guide vane modulates the static pressure at the setpoint of 1" WC.

Recommendations

1. Calibrate the cold deck temperature sensor.
2. Reset cold deck temperature based on outside air temperature.
3. Optimize the static pressure setpoint.

Field House

Building information

This building houses offices and classrooms. There is one 50 ton chiller and one 1,000,000 Btu/hr boiler for this building. There is one 5 hp building chilled water pump and one 5 hp hot water pump.

There is one single-zone AHU that serves the lobby and snack bar. The rest of the building is served by FCUs using a two-pipe system.

Recommendations

1. Reset the hot water supply temperature for the 2-pipe system.

Performing Arts Center

Building information

This building houses a radio station, an auditorium and offices. There are two 120 ton chillers and one 1.76 MMBtu/hr boiler for this building.

There are seven AHUs in this building. AHUs #1 and #2 are single-duct VAV systems. It is not clear how the air flow is being controlled. AHUs #3 to #5 are single-zone units with no chilled water control valves or hot water control valves. AHUs #6 and #7 are single-zone units with face and bypass dampers and hot water control valves, but without chilled water control valves.

Recommendations

1. Calibrate the cold deck temperature sensors.
2. Install control valves for the cooling coils and heating coils.
3. Optimize the VAV AHUs' control.

Whitley Hall

Building information

This is a high-rise dorm. There are two 120 ton chillers and one 4.5 MMBtu/hr boiler for this building. It has a two-pipe system.

Whitley Gym

Building information

This is a gym with some offices. The building obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 5 hp building chilled water pump. Steam from the boilers in the Journalism Building is used to produce hot water. There is one 5 hp hot water pump.

There are two multi-zone AHUs. The multi-zone AHUs have chilled water control valves and hot water control valves. Both AHUs' outside air dampers are disconnected. One chilled water valve's electric to pneumatic (EP) transducer board is missing. Its chilled water control valve is being bypassed and the cold deck temperature is 50°F. There is also one coupled-control AHU with a chilled water control valve and a steam control valve.

Recommendations

1. Calibrate the cold deck and hot deck temperature sensors.
2. Replace the EP transducer board.
3. Reset the cold deck and hot deck temperatures based on outside air temperature.
4. Reconnect the outside air dampers.

Art Building

Building information

This building houses offices, classrooms and an art gallery. It obtains chilled water from the chilled water loop served by the chiller in the Journalism Building. There is one 5 hp building chilled water pump. It has its own boiler and one 1.5 hp hot water pump.

There is one multi-zone AHU and one single-zone AHU. No control valves are installed in the coils. Cold deck temperature was 49°F for the multi-zone unit.

Recommendations

1. Calibrate the cold deck and hot deck temperature sensors.
2. Install control valves for the cooling coils and heating coils.

3. Reset the cold deck and hot deck temperatures based on outside air temperature.

Music Building

Building information

This building houses offices, practice rooms and a concert hall. It has one 80 ton air-cooled chiller and one 1.4MMBtu/hr boiler.

There are four AHUs in this building. AHU #1 is a single-zone unit with one coil. This coil can be either a cooling coil or a heating coil depending on the mode of operation. There is no control valve. The fan belt was found broken. AHUs #2 to #4 are single-zone units with face and bypass dampers. There are no control valves for the cooling and heating coils.

Recommendations

1. Install control valves for the cooling coils and heating coils.

Zeppa Recreation Center

Building information

There are nine rooftop units with DX cooling and gas heating for this building.

Key Hall

Building information

This is a mini-plant that serves the dorms. There are two 200 ton chillers and two 3.4MMBtu/hr boilers in this plant. The two-pipe system provides either cooling or heating to the dorms through two 20 hp pumps. Hot water temperature is manually set at 170°F when in operation.

Recommendations

1. Reset the hot water supply temperature.
2. Optimize the chiller and chilled water pumps operation.

Electricity Deregulation Metering Options

Option 1: Buy the 15-minute time interval utility data from TXU for the two main campus meters.

Option 2: Install the ESL metering to monitor the total electricity and gas consumption.

The gas data would be necessary for the energy efficiency program because of the large gas consumption on the campus.

Utility Bill Summary

Month	Electricity			Natural Gas		Total costs (\$)
	Energy (kWh)	Energy Costs (\$)	Demand (kW)	Gas (MCF)	Gas Costs (\$)	
Apr-98	2,851,204	131,529		4,882	20,301	151,830
May-98	3,180,499	141,461		2,470	10,141	151,602
Jun-98	3,930,471	164,779	6,867	1,892	6,586	171,365
Jul-98	3,644,985	157,075	6,745	1,602	6,372	163,447
Aug-98	3,576,077	158,546	7,051	1,700	5,625	164,171
Sep-98	3,986,120	168,697	7,124	1,884	6,094	174,791
Oct-98	2,976,668	138,440	6,474	2,814	10,376	148,816
Nov-98	2,799,625	132,447	6,297	8,318	29,918	162,365
Dec-98	2,312,031	119,310	6,042	16,621	59,421	178,731
Jan-99	2,553,938	125,890	6,126	17,075	53,860	179,750
Feb-99	2,765,565	131,320	6,153	12,333	40,198	171,518
Mar-99	2,418,210	122,017	6,046	8,666	26,392	148,409
Total	36,995,393	1,691,511		80,257	275,284	1,966,795